

DETAILED ACTION

This Office Action corresponds to application 10/675,505. Claims 1, 3, 10, 11, 14, 17, 21, 25, 26, 28-30, 32-34, and 36 (now renumbered 1-16) have been allowed over the prior art of record.

Response to Amendment

Amendments submitted 4/20/2010 have been accepted and entered. In light of the amendments and Applicant's response filed 4/20/2010, the objection to the drawings and rejection of claims 28, 32, and 36 under 35 U.S.C. 112 first paragraph are withdrawn.

Response to Arguments

Applicant's arguments, see pages 14-16, filed 4/20/2010, with respect to the rejection of the claims under 35 U.S.C. section 102(e) and 35 U.S.C. section 103 have been fully considered and are persuasive. Those rejections have been withdrawn in light of the arguments and accompanying amendments.

Examiner's Amendment

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview and correspondence with representing attorney, Ana Luther (61,704) on 6/3/2010.

Claims 1, 14, 17, 21, 26, 27, 30, 31, 34, and 35 have been amended as follows:

1. **(Currently Amended)** A method comprising:
replicating data from a first volume to a second volume, wherein
the replicating comprises copying to the second volume only data from regions of the
first volume that are modified by application-driven update operations, ~~wherein~~
and
the application-driven update operations are initiated by an application managing data in
the first volume;
while the replicating the data from the first volume is being performed, detecting a change to a
first region of the first volume, wherein
the change is caused by a restore operation to restore the first volume from a third
volume, ~~wherein~~
the restore operation is not an application-driven update operation initiated by the
application,
the change is detected by detecting the restore operation and accessing a restoration
data structure,
the restoration data structure identifies regions of the first volume that are not
synchronized with the third volume, and
the change to the first region caused by the restore operation is not designated for
replication from the first volume to the second volume at the time of the
detecting;
in response to the detecting, adding information identifying the first region to a **replication** data
structure, wherein
the adding comprises combining the replication data structure with the restoration
data structure,

the replication data structure identifies regions of the first volume that are designated for replication to the second volume, wherein
the regions of the first volume designated for replication to the second volume are regions of the first volume that are modified by application-driven update operations and the first region of the first volume changed by the restore operation, and
the adding is performed while the replicating is being performed; and
in response to the adding the information to the replication data structure, replicating data modified by the restore operation from the first region of the first volume to the second volume, wherein
the replicating the data from the first region is performed while the replication of the data modified by the application-driven update operations from the first volume is ongoing, and ~~wherein~~
the replicating the data from the first volume, the detecting, the adding, and the replicating the data from the first region ~~[[is]]~~ are performed by a computing device implementing a replication facility.

14. **(Currently Amended)** A system comprising:
a processor;
computer-implemented means for replicating data from a first volume to a second volume,
wherein
the replicating comprises copying to the second volume only data from regions of the first volume that are modified by application-driven update operations, ~~wherein~~
and
the application-driven update operations are initiated by an application managing data in the first volume;
computer-implemented means for detecting a change to a first region of the first volume while the data is being replicated from the first volume, wherein
the change is caused by a restore operation to restore the first volume from a third volume, and ~~wherein~~

the restore operation is not an application-driven update operation initiated by the application,

the change is detected by detecting the restore operation and accessing a restoration data structure,

the restoration data structure identifies regions of the first volume that are not synchronized with the third volume, and

the change to the first region caused by the restore operation is not designated for replication from the first volume to the second volume at the time of the detecting;

computer-implemented means for, in response to detection of the change, adding information identifying the first region to a replication data structure, [[,]] wherein

the information is added to the replication data structure by combining the replication data structure with the restoration data structure,

the replication data structure identifies regions of the first volume that are designated for replication to the second volume,

the regions of the first volume designated for replication to the second volume are regions of the first volume that are modified by application-driven update operations and the first region of the first volume changed by the restore operation, and ~~wherein~~

the information is added while the data is being replicated from the first volume; and

computer-implemented means for, in response to the addition of the information, replicating data modified by the restore operation from the first region of the first volume to the second volume, wherein

the data from the first region is replicated while the data modified by the application-driven update operations is being replicated from the first volume.

17. **(Currently Amended)** A system comprising:
a processor; and

a memory coupled to the processor, wherein the memory stores program instructions executable by the processor to implement a replication facility, and wherein the replication facility is configured to:

replicate data from a first volume to a second volume by copying to the second volume only data from regions of the first volume that are modified by application-driven update operations, wherein the application-driven update operations are initiated by an application managing data in the first volume;

while data from the first volume is being replicated, detect a change to a first region of the first volume, wherein the change is caused by a restore operation to restore the first volume from a third volume, ~~and wherein~~ the restore operation is not an application-driven update operation initiated by the application,

the change is detected by detecting the restore operation and accessing a restoration data structure,

the restoration data structure identifies regions of the first volume that are not synchronized with the third volume, and

the change to the first region caused by the restore operation is not designated for replication from the first volume to the second volume at the time of the detecting;

in response to detection of the change, add information identifying the first region to a **replication** data structure, wherein

the information is added to the replication data structure by combining the replication data structure with the restoration data structure,

the **replication** data structure identifies regions of the first volume that are designated for replication **to the second volume,**

the regions of the first volume designated for replication to the second volume are regions of the first volume that are modified by

application-driven update operations and the first region of the first volume changed by the restore operation, and ~~wherein~~

the information is added while the data from the first volume is being replicated;
and

in response to the addition of the information, replicate data modified by the restore operation from the first region of the first volume to the second volume, wherein the data modified by the application-driven update operations from the first region is replicated while the data is being replicated from the first volume.

21. **(Currently Amended)** A computer-readable storage medium comprising program instructions executable to:

replicate data from a first volume to a second volume by copying to the second volume only data from regions of the first volume that are modified by application-driven update operations, wherein the application-driven update operations are initiated by an application managing data in the first volume;

while data from the first volume is being replicated, detect a change to a first region of the first volume, wherein the change is caused by a restore operation to restore the first volume from a third volume, ~~and wherein~~ the restore operation is not an application-driven update operation initiated by the application,

the change is detected by detecting the restore operation and accessing a restoration data structure,

the restoration data structure identifies regions of the first volume that are not synchronized with the third volume, and

the change to the first region caused by the restore operation is not designated for replication from the first volume to the second volume at the time of the detecting;

in response to detection of the change, add information identifying the first region to a replication data structure, wherein
the information is added to the replication data structure by combining the replication data structure with the restoration data structure,
the replication data structure identifies regions of the first volume that are designated for replication to the second volume,
the regions of the first volume designated for replication to the second volume are regions of the first volume that are modified by application-driven update operations and the first region of the first volume changed by the restore operation, and ~~wherein~~
the information is added while the data from the first volume is being replicated;
and
in response to the addition of the information, replicate data modified by the restore operation from the first region of the first volume to the second volume, wherein the data from the first region is replicated while the data modified by the application-driven update operations is being replicated from the first volume.

26. (Currently Amended) The method of claim 1, wherein
the replication data structure comprises a replication bitmap,
the restoration data structure comprises a restoration bitmap, and
~~wherein the adding comprises~~ replication data structure is combined with the restoration data structure by performing a logical OR operation to combine the replication bitmap with ~~[[a]]~~ the restoration bitmap ~~identifying regions affected by the restore operation.~~

27. (Cancelled)

30. (Currently Amended) The system of claim 17, wherein
the replication data structure comprises a replication bitmap,
the restoration data structure comprises a restoration bitmap, and

~~wherein the information is added to the data structure~~ **replication data structure is combined with the restoration data structure** by performing a logical OR operation to combine the replication bitmap with ~~[[a]]~~ **the** restoration bitmap ~~identifying regions affected by the restore operation.~~

31. (Cancelled)

34. (Currently Amended) The computer readable storage medium of claim 21, wherein

the **replication** data structure comprises a replication bitmap, **the restoration data structure comprises a restoration bitmap,** and ~~wherein the information is added to the data structure~~ **replication data structure is combined with the restoration data structure** by performing a logical OR operation to combine the replication bitmap with ~~[[a]]~~ **the** restoration bitmap ~~identifying regions affected by the restore operation.~~

35. (Cancelled)

Allowable Subject Matter

The following is an examiner's statement of reasons for allowance:

The present invention is directed towards an ongoing replication process that detects changes made by a restore operation to a first region of a first volume. Those changes by the restore operation occur while the replicating is performed and are detected by detecting the restore operation and accessing a restoration data structure the restoration data structure identifies regions of the first volume that are not synchronized with the third volume, and the change to the first region caused by the restore operation is not designated for replication from the first volume to the second

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volume at the time of the detecting. When those changes are detected, information identifying the first region is added to a replication data structure by combining the replication data structure with the restoration data structure.

Independent claim 1 (as amended) in the present application includes the following limitation not expressly found or suggested by the cited prior art:

while the replicating the data from the first volume is being performed, detecting a change to a first region of the first volume, wherein

the change is caused by a restore operation to restore the first volume from a third volume,

the restore operation is not an application-driven update operation initiated by the application,

the change is detected by detecting the restore operation and accessing a restoration data structure,

the restoration data structure identifies regions of the first volume that are not synchronized with the third volume, and

the change to the first region caused by the restore operation is not designated for replication from the first volume to the second volume at the time of the detecting;

in response to the detecting, adding information identifying the first region to a **replication** data structure, wherein

the adding comprises combining the replication data structure with the restoration data structure,

the **replication** data structure identifies regions of the first volume that are designated for replication **to the second volume,**

the regions of the first volume designated for replication to the second volume are regions of the first volume that are modified by application-driven update operations and the first region of the first volume changed by the restore operation, and

the adding is performed while the replicating is being performed.

The closest prior art relied upon, Earl et al. ('Earl' hereafter) recites a continuous replication system that continuously scans and replicates database log files. Earl further discovers updates since a last scanning process. Although Earl is pertinent to the present invention by disclosing the discovery of changed data during a continuous replication process (i.e. "while replicating"), Earl is silent as to explicitly disclose the detection of a change to a first region of the first volume by a restore operation and the method of adding information in response to the detecting by combining a replication data structure with a restoration data structure as specifically claimed in the cited limitation above. Accordingly, Earl is not seen to expressly teach or suggest at least all of the elements in the cited claim portion above in combination with the other recited claim elements.

Another relevant prior art, Tamer et al. ('Tamer' hereafter), teaches maintaining bit maps that identify which portions of volumes are out of sync with their counterparts (col. 7 lines 62-64) and identifies restored tracks as changes recorded in the bit maps (col. 12 lines 25-27); however, likewise to Earl, Tamer does not explicitly disclose the detection of a change to a first region of the first volume by a restore operation and the method of adding information in response to the detecting by combining a replication

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data structure with a restoration data structure as specifically claimed in the cited limitation above. Accordingly, Tamer is not seen to expressly teach or suggest alone or in combination with Earl at least all of the elements in the cited claim portion above in combination with the recited claim elements.

The remaining independent claims 14, 17, and 21 recite the same features as claim 1 and therefore are allowed for the same reasons as claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT TIMBLIN whose telephone number is (571)272-5627. The examiner can normally be reached on M-Th 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R. Cottingham can be reached on 571-272-7079. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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